

Claims

Process for conveying solid particles

1. A process for conveying solid particles of irregular geometry through at least one pipe or pipe system having a curve or several curves and/or a kink or several kinks, where a fluid is used for conveying the solid particles,

wherein, for conveying the solid particles of irregular geometry as first solid particles, second solid particles of regular geometry are admixed with them and wherein the solid particles are conveyed with gas as the fluid.

2. Process according to Claim 1,

wherein solid particles of polygonal geometry are used as the first solid particles.

3. Process according to Claim 1, wherein solid particles with spherical or ellipsoid geometry are admixed as second solid particles.

4. Process according to Claim 1, wherein the proportion of first solid particles is approximately 1 % to about 50 % of the total quantity of first and second solid particles.

5. Process according to Claim 1, wherein the solid particles are conveyed by means of fluid packages.

6. Process according to Claim 1, wherein the fluid is supplied to the pipe or pipe system in pulses.

7. Process according to Claim 6, wherein the fluid is pulsed at regular or irregular intervals.

8. Process according to Claim 1, wherein the first solid particles have an elongated form with a width B and a length L in a length-to-width ratio of $L : B$ of about ≤ 3 .

9. Process according to Claim 1 or Claim 8, wherein the maximum length L of the first solid particles is the radius of the pipe.

10. Process according to Claim 1, wherein the first and second solid particles comprise or contain silicon.

11. Process according to Claim 1, wherein broken silicon material is used as the first solid particles.

12. Process according to Claim 11, wherein fragments of CVD polysilicon rods, fragments of multicrystalline blocks, fragments and/or end pieces of silicon single crystals, and fragments of monocrystalline or multicrystalline wafers are used as broken silicon material.

13. Process according to Claim 1, wherein the solid particles are supplied to a silicon melt.

14. Process according to Claim 13, wherein the silicon melt is doped using doping elements present in the first solid particles.

15. Process according to Claim 14, wherein boron and phosphorus, elements of the IIIrd group and/or of Vth group of the periodic table are used as doping elements.

16. Process according to Claim 13, wherein highly doped first solid particles of the doping $p^+_1, p^+_2, \dots p^+_n$ of the doping concentration p^+_i with $1 \times 10^{17} \text{ cm}^{-3} \leq p^+_i \leq 1 \times 10^{20} \text{ cm}^{-3}$, in particular with $P^+_1 : 1 \times 10^{18} \text{ cm}^{-3} \leq p^+_i \leq 1 \times 10^{19} \text{ cm}^{-3}$, in the quantities m^+_1 bis m^+_n are mixed together with second less doped solid particles of the concentrations p_1, p_2, \dots, p_m of the doping concentration p_j with $1 \times 10^{13} \text{ cm}^{-3} \leq p_j \leq 1 \times 10^{17} \text{ cm}^{-3}$, in particular with $p_j : 1 \times 10^{14} \text{ cm}^{-3} \leq p_j \leq 1 \times 10^{16} \text{ cm}^{-3}$ in the quantities m_1 bis m_m such that a resultant doping of the melt p_r is obtained, where the following equation applies:

$$\sum_{i=1}^n m^+_i p^+_i + \sum_{j=1}^m m_j p_j = p_r \left(\sum_{i=1}^n m_i + \sum_{j=1}^m m_j \right) .$$

17. Process according to Claim 1, wherein the solid particles are accelerated in one or more

sections of the at least one pipe or pipe system.

18. Process for manufacturing solid silicon by crystallization of the silicon from a silicon melt, where crystalline silicon grown from the silicon melt present in a container is supplied
5 appropriately to the silicon melt comprising or containing solid material,

wherein the solid material comprises or at least contains first and second solid particles, wherein the first solid particles comprise broken silicon material and the second solid particles have a spherical or ellipsoid geometry and wherein the solid material is conveyed by a fluid.

10 19. Process according to Claim 18, wherein the solid material is conveyed through a pipe passing through the center of the melt or being concentrically surrounded thereby, wherein the solid particles are deflected in the direction of the container by a deflecting element arranged above the pipe and having a conical geometry, and wherein the solid particles are passed into the melt by a baffle element surrounding the pipe, passing round the outer edge in the area of the
15 melt and having a spherical surface section geometry.

20. Process according to Claim 1 or Claim 18, wherein a gas comprising compressed air, nitrogen, argon and/or carbon dioxide or a mixture thereof is used as the fluid.

20 21. Process according to Claim 18, wherein silicon wafers are manufactured using the Edge-Defined Film-Fed Growth process.

22. Process according to Claim 19, wherein the deflecting element having a conical geometry and the baffle element are adapted in their geometry to the morphology and to the mixing ratio of
25 the solid particles.

23. Process according to Claim 19, wherein the temperature of the baffle and/or deflecting element is set in the range between 300°C and 1200°C, preferably between 1000°C and 1120°.

30 24. Process according to Claim 19, wherein the deflecting element having a conical geometry has an opening angle α of preferably $30^\circ \leq \alpha \leq 60^\circ$, in particular α around 45° , and at its base a diameter d and the baffle element at its base a diameter D with $0.2 \leq d/D \leq 0.8$.